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EXPERIMENTAL INVESTIGATION ON PERFORMANCE OF A COMPRESSION IGNITION ENGINE FUELLED WITH LINSEED (FLAX) METHYL ESTERS

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ABSTRACT

The present work particularly aims at assessment of performance in exhaust emissions of linseed oil with diesel fuel in single cylinder engine powered by diesel. Due to higher viscosity levels and slight lower calorific value of the Linseed oil it can be used with or without diesel blends. A biofuel is an alternative to diesel, produced from the living organisms, plant-derived materials. Plant makes sure of atmospheric co2 via photosynthesis by producing polysaccharides, such as cellulose and hemicellulose because they are extracted from the plant polysaccharides, co2 does not exceed with the use of biofuels (combusted), which refers to the concept of carbon neutrality. The results of the experiment showed that the performance of the engine on linseed oil was slightly inferior to that on diesel fuel. The thermal efficiency of the engine was lower and the brake specific energy consumption of the engine was higher when the engine was fuelled with linseed oil compared to diesel fuel. The oxides of nitrogen from during the whole range of experiment were lower than diesel fuel. The carbon monoxide, unburned hydrocarbon from the fuel was found higher than diesel fuel during the whole experimental range.

Keywords: Methyl Esters, Biofuels, Thermochemical.

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1. INRODUCTION

A biofuel is an alternative to diesel, produced from the living organisms, plant-derived materials. Plant makes sure of atmospheric co_2 via photosynthesis by producing polysaccharides, such as cellulose and hemicellulose because they are extracted from the plant polysaccharides, co_2 does not exceed with the use of biofuels (combusted), which refers to the concept of carbon neutrality. Thus, use of these fuels is an effective and efficient way to fight against the global climatic changes by reducing the co_2 emission. Non-food based biomasses such as rice straw, forest thinning residues, corn stover, are promising resources for biofuel production since use of non-food-based biomass does not compete with food production with respect to land use. There are two technics used to realize biofuels extracted from non-food biomass, one is the technology for efficient conversion of pentose to biofuel and the other is mitigation of fermentation inhibition by organic compounds (aromatics, organic acids and furans). Although polysaccharides mostly composed of non-food biomass possess pentose sugars (xylose and arabinose) along with hexose sugars (glucose, mannose and galactose), microorganisms used in industrial bioprocess are incapable for the usage of pentose sugars, lead to low yield in the production of biofuels. Inhibitory compounds are produced in a thermochemical treatment step (referred to pre-treatment) of non-food biomass, but this step is required for efficient enzymatic saccharification of biomass. Petrol and diesel contains 85 – 87% carbon in their composition which is the main cause for pollution. The emissions from these vehicles contain carbon monoxide and toxic substances like NOx which result in serious health problems. So the development in alternate fuels for petroland diesel is a must for the reduction of toxic emissions. We are blending the linseed oil with methyl esters and with diesel. Instead of directly injecting the blended diesel, the obtained fuel is transesterified for the removal of fatty acids from the oil which results in knocking. to focus mainly on reduction of emissions of the vehicle by reducing the carbon content in the fuel which leads to better exhaust by reducing the major parameters like knocking, corrosion, NOx emissions from the tail pipe. The blended fuel is not directly used in ci engine; the proportions like b5, b10, b20, b30 and b40 are taken and tested to achieve the required parameters. The best bio fuel is considered as one of the alternative for the diesel among the other biofuels.

1.2. TRANSESTERIFICATION

Trans-esterification of oils extracted from vegetables, waste cooking oils, or animal fats is the process undergone for conventional biodiesel. In the process of Transesterification a glyceride get reacted with alcohol (methanol or ethanol) in presence of catalyst forming fatty acid alkyl esters and alcohol.

The process of trans-esterification is one of the reversible reactions, which is carried by a mixture of the reactant fatty acids, catalyst and alcohol. Strong base or else a strongacid can be used as catalyst. At the industry, mostly sodium or potassium methanol is used. The products obtained at the end of the Trans esterification process are raw biodiesel, glycerol. The glycerol is used as one of the substrate for anaerobic digestion.

The oil obtained by mechanical press process of the seeds contains abundant impurities and the obtained oil is purified by the use of serigraphic papers. A sample of linseed oil is taken into a beaker and pre-heated at 55–60 degrees using a magnetic stirrer for the removal of water vapours inside the oil the transesterified oil is taken into a separating funnel and allowed it to settle for 36 to 48 hrs. So that the fatty acids get accumulated at the bottom of the funnel and after that the fatty acids are removed, the oil is cleaned by pouring the hot water into the funnel for the removal of dust particles.

2. LITERATURE SURVEY

Ashutosh Kumar Rai a research scholar from the Department of Mechanical engineering in Delhi Technological University reported that the oil seed crops provides a fuel grade product using relatively simple extraction, processing technology could be performed on individual farms. Vegetable oils are one of the most promising fuels, particularly for diesel engines. The oils from vegetables as diesel fuels has been sufficiently demonstrated to warrant further investigation of their effectiveness and to develop techniques that will permit, incorporation into agricultural operations, particularly in case of energy shortfall. The present work particularly aims at assessment of performance in exhaust emissions of linseed oil with diesel fuel in single cylinder engine powered by diesel. Due to higher viscosity levels and slight lower calorific value of the Linseed oil it can be used with or without diesel blends.

Diesel fuels have different chemical reaction structure than vegetable oil. The previous contain only carbon and hydrogen atoms which were arranged in normal or branched structures in chain as well as aromatic configurations. The usual structure is suited for better ignition quality. Diesel fuel contains mostly saturated and unbranched, unsaturated chain hydrocarbons, but the later is not present in large amounts to make problems oxidation a problem. Vegetable oils contain triglycerides about 97%; and 3% distribute among the di, mono glycerides and further 3 fatty acids and fat accompanying are mostly be removed through refining.

3. LOW CHART OF PROCEDURE

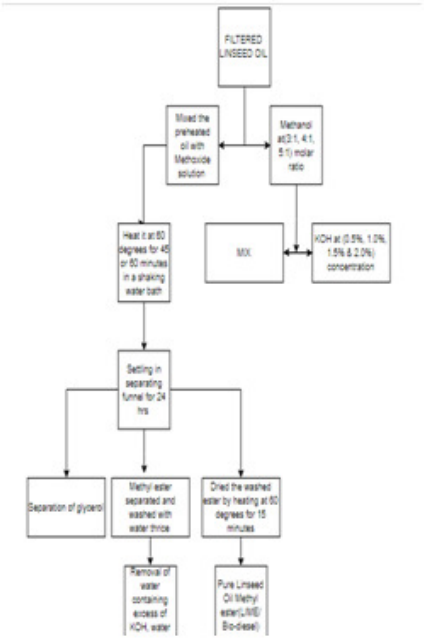

Figure 3.1 Sequential procedure

4. EXPERIMENTAL PROCEDURE

4.1. PROCEDURAL STEPS

- Firstly, take linseed oil (200ml), methanol (50ml) and 5 grams of KOH pallets are taken in a glass beaker.
- Secondly, by using Magnetic Stirrer Heater, heat the solution to 60 degrees for 3 hours while this process was going on we should observe it carefully.

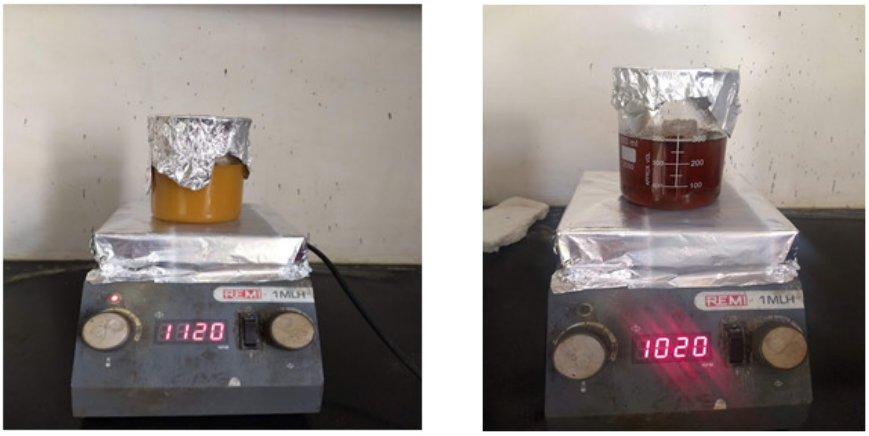

Figure 4.1 Heating oil on Ultrasonicator

- We dip magnetic stirrer to inside the solution while heating process was going on so that the linseed oil, methanol and KOH pallets can mix thoroughly and for the removal of water vapours.
- After completing the trans-esterification process take that trans-esterified oil into a separating funnel, allow it to settle for 24 to 36 hours.

Figure 4.2 Oil poured in separating funnel with black spots removal

- The fatty acids present in the oil and the impurities present in the oil is settled at the down part of the separating funnel.

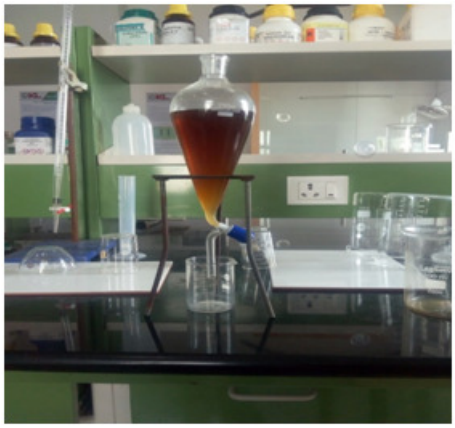

Figure 4.3 Oil after removal of impurities

- Open separating funnel lid and collect the fatty acids into a small beaker and , on the other hand heat the water 45 to 50 degrees and pour the water in separating funnel.

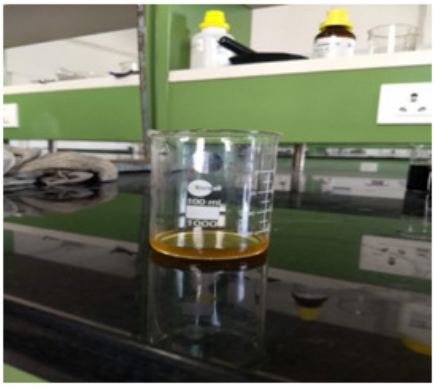

Figure 4.4 waste oil with impurities

- After pouring water wait for 5 minutes so that water can settle down and it can bring the small impurities present in the oil. Remove water by opening the lid of a separating funnel.

Figure.4.5 Hot water Bath

- Then collect the oil into a bottle and repeat the experiment for 4 to 5 times, so that we get 1000ml of oil.
- Before blending the oil is heated again at 60 – 70 degrees to remove the water vapour present inside the oil.

Figure 4.6 Heating the Biodiesel to remove Water vapour

- We can blend our oil with diesel in appropriate proportions like b5, b10, b20, b30 (b5 means 5% of transesterified oil, 95% diesel) for testing the engine performance.

Figure 4.7 Bio diesel blends

- The blends are tested in the computerized C.I engine and the values like brake power, indicated power are noted down to calculate the mechanical efficiency.
- Finally, the mechanical efficiency of the diesel and the mechanical efficiency of the blended fuels are compared and suggested the best alternative blend for the diesel.

5. RESULTS

Results obtained for:bB5:

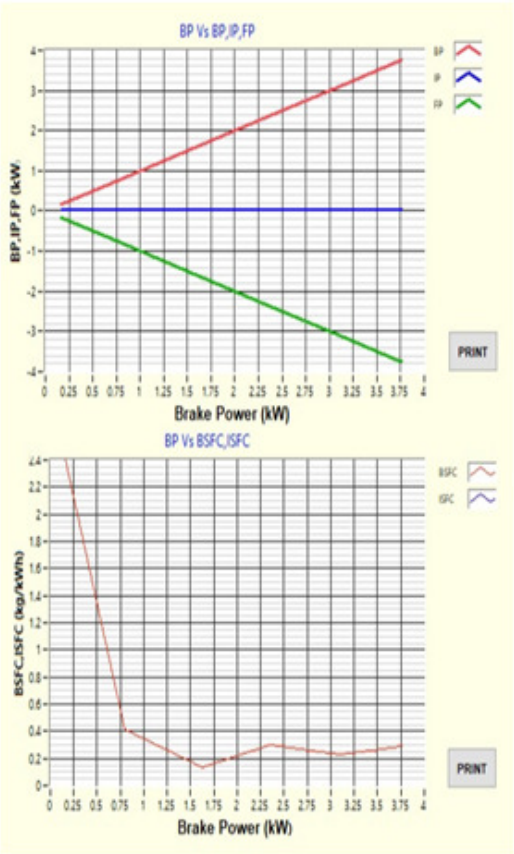

Figure 5.1 B5 performance characteristic Graphs

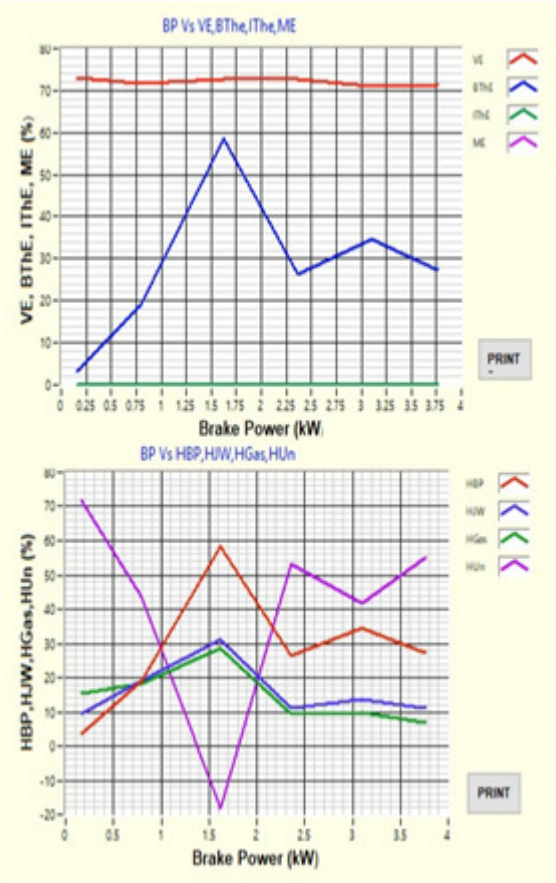

Figure 5.2 characteristic curves

- From the graph, bp vs bp, ip, fp we can say that as the brake power increases gradually there is an increase in indicated power. Simultaneously, the frictional power decreases.
- By comparing the brake power with ve, b the, it he the maximum brake thermal efficiency is achieved at 59.6% and the volumetric efficiency lies in between the range of 71-75%.
- Coming to the fuel consumption rate with the increase of brake power the bsfc, isfc is reduced.
- There will be a sudden drop in hun and an increase in hbp at 1.7kw of brake power.

B10:

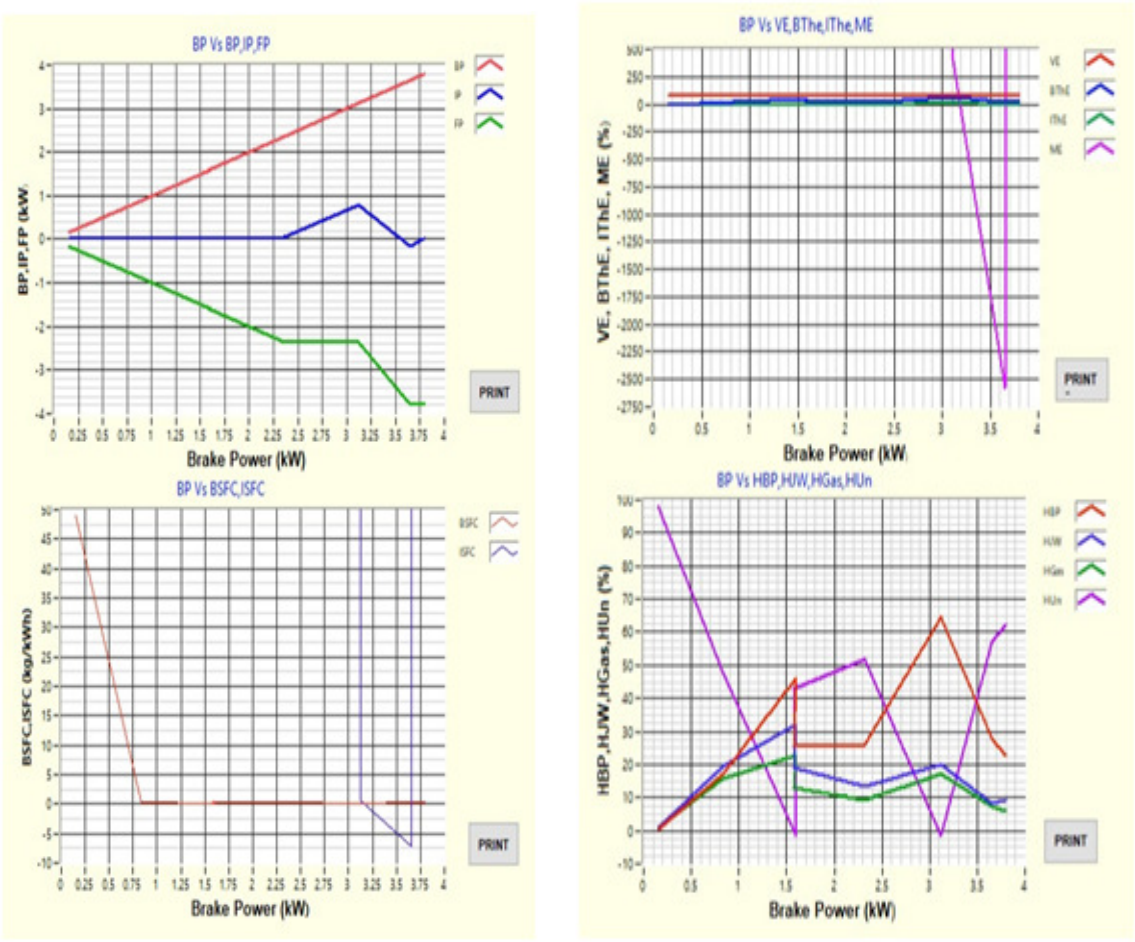

Figure 5.3 B10 performance characteristic Graphs

- With the increase of brake power, the indicated power increases and in case of frictional power it reaches a steady state at 2.26-3.20kw of brake power.
- In the brake power vs bsfc, isfc the isfc rate is lesser than bsfc.
- The volumetric efficiency is almost equal with the brake thermal efficiency and indicated thermal efficiency.

B20:

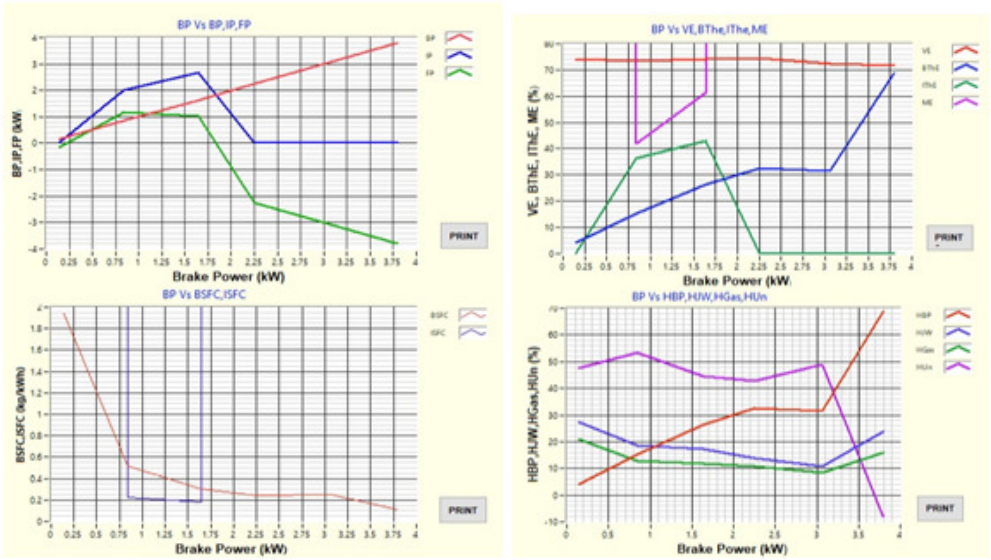

Figure 5.4 B20 performance characteristic Graphs

- In this blend the indicated power and frictional power are almost same but at 2.25 Kw of brake power the frictional power gradually reduces.
- The isfc is less with the increase of bp.
- The mechanical efficiency ranges in between 45-75% and the volumetric efficiency ranges at 73-75%.
- Brake thermal Efficiency increases with the increase of brake power.
- The hbp value increases whereas hjw and hgas values decrease with an increase of brake power.

B30:

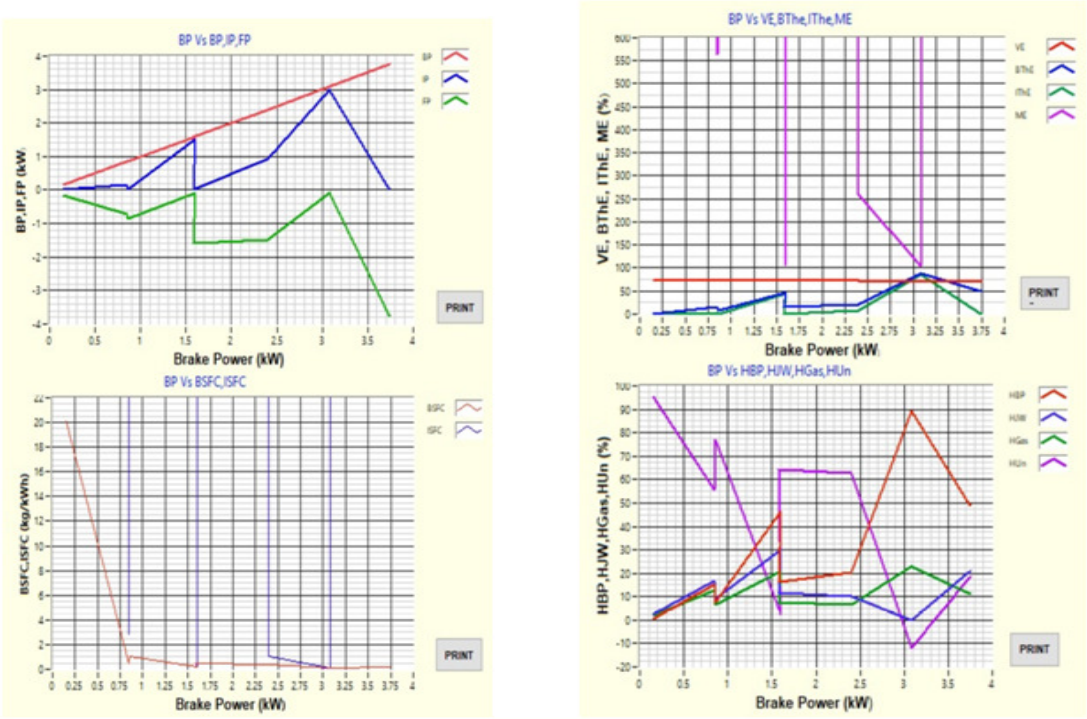

Figure 5.5 B30 performance characteristics Graphs

- In this blend, by observing the above graph we can say that the engine experiences lot of combustion problems as the BSFC and ISFC almost comes to zero which leads to improper combustion.
- The compression ratio for this blend need to be high than 16.5.
- At higher loads the brake thermal efficiency and indicated thermal efficiency are very high.

D100:

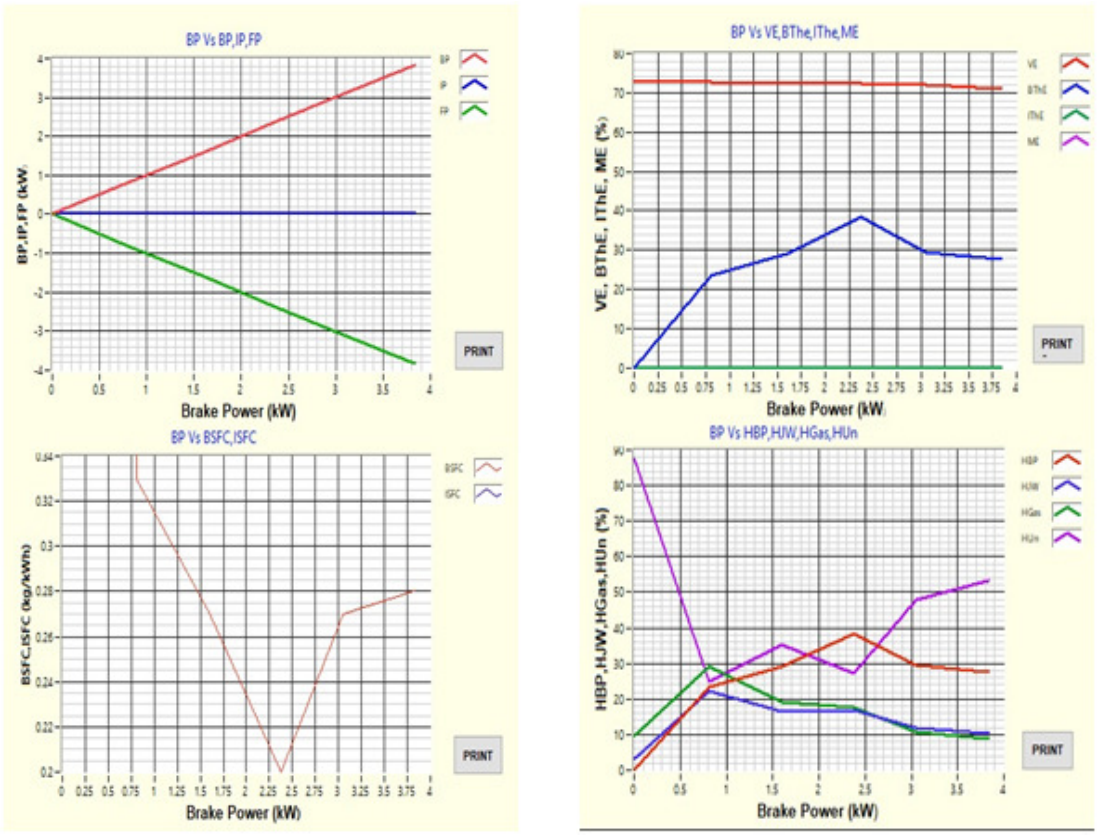

Figure 5.6 D100 performance characteristics Graphs

- By comparing all the above graphs with D100, the B5 and B10 properties are almost similar.
- The indicated thermal efficiency attained in B5 and B10 are nearer to D100.
- Coming to mechanical efficiency B20 is an appropriate alternative to D100.

6. CONCLUSION

The results of the experiment showed that the performance of the engine on linseed oil was slightly inferior to that on diesel fuel. The thermal efficiency of the engine was lower and the brake specific energy consumption of the engine was higher when the engine was fuelled with linseed oil compared to diesel fuel. The oxides of nitrogen from during the whole range of experiment were lower than diesel fuel. The carbon monoxide, unburned hydrocarbon from the fuel was found higher than diesel fuel during the whole experimental range. The results from the experiments suggest that linseed oil is potentially good substitute fuel for diesel engine and performance and emissions characteristics were found to be comparable to diesel fuel. The blend b-10 has shown the commendable results in the air fuel ratio over other blends. Blends b-10 and b-20 have shown nearly the same results in mechanical efficiency and in volumetric efficiency investigation blends b-5, b-10 and b-20 have shown the similar results.

7. FUTURE SCOPE

In the coming days, there is a possibility of lack of conventional fuels, and finding its alternative is the best way without effecting the environmental conditions is going to be proved as the best alternative fuel. but it is a fact that there must be engine modifications for higher biofuel proportional fuels like b30, b40 etc.... hence the low blended fuels like b5, b10, b15 are appropriate for usage with little efforts. As of now, indeed of the problems and difficulties of biofuels, biofuel is the best alternative fossil fuel for most manufacturing and vehicular uses. While coming to the electric and hydrogen technologies may come to replace biofuels, they are not yet possible alternatives on the current global scale. For now, biofuels improvement is the best to hope for.

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